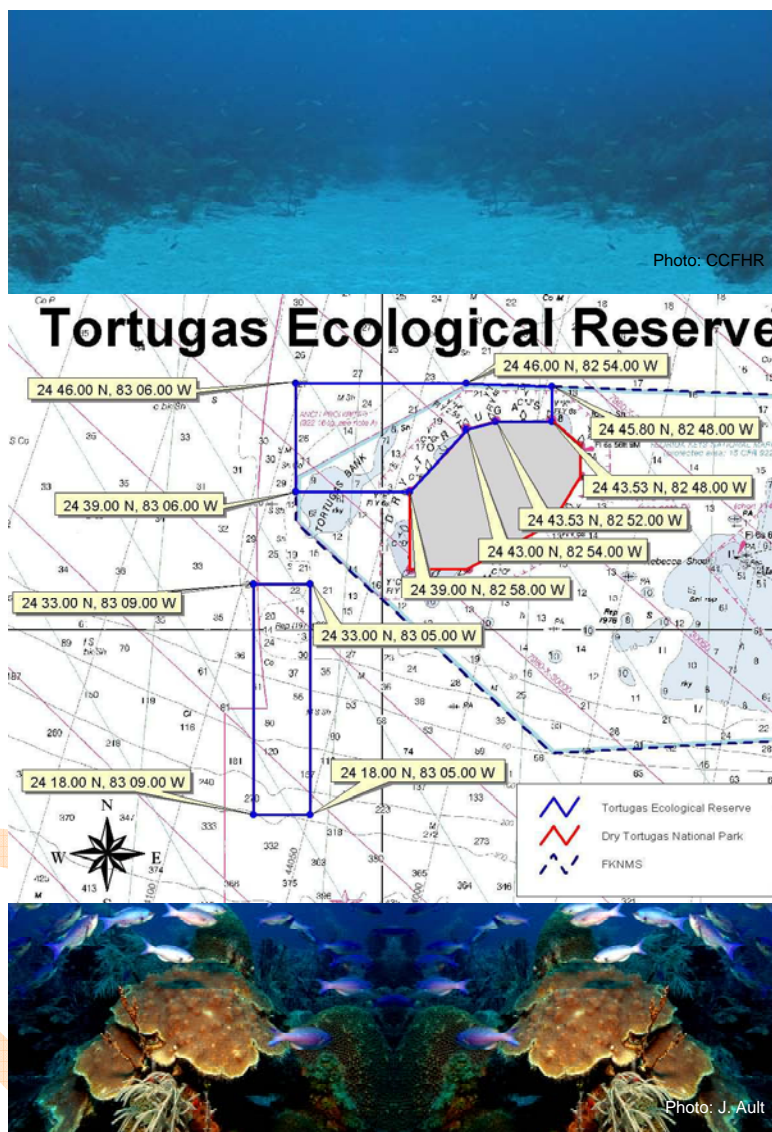


# DRAFT WORKPLAN

## AN INTEGRATED BIOGEOGRAPHIC ASSESSMENT OF THE TORTUGAS ECOLOGICAL RESERVE



*A cooperative Investigation by NCCOS (Center for Coastal Monitoring and Assessment and Center for Coastal Fisheries and Habitat Research), NOS Special Projects Office, NFMS Southeast Fisheries Science Center, Colorado State University, University of Maryland, University of Massachusetts-Amherst (Human Dimensions Research Unit), University of Miami (Rosenstiel School of Marine and Atmospheric Sciences), and Texas A & M University, and in consultation with the National Marine Sanctuaries Program.*

**June 2, 2005**

**Principal Investigators: Mark Monaco and Mark Fonseca**  
**Project Manager: Christopher Jeffrey**

## GOALS

To conduct an Integrated Biogeographic Assessment of reef fishes and their associated habitats in order to determine existing or potential biological and human (societal) benefits or impacts resulting from implementation of the Tortugas Ecological Reserve (TER).

**PROJECT PERIOD:** March 1, 2005 to December 31, 2006.

## OBJECTIVES

1. Synthesize the best possible habitat map of the TER based on available remotely sensed data
2. Synthesize and integrate existing ecological reef fish datasets for the TER within a biogeographic framework.
3. Describe biological responses of ecosystem components following implementation of the TER and use biological models to identify potential biological benefits of the TER to surrounding areas.
4. Develop an approach for including human dimensions research and information within an Integrated Biogeographic Assessment of the TER, review human dimensions research relevant to the TER, and develop a summary document that would be a useful and supporting component of an Integrated Biogeographic Assessment of the TER.
5. Assess current data on levels of toxic contaminants, nutrients, and pathogens in the TER and determine additional data needs, an appropriate sampling strategy, and how best to incorporate such data into an Integrated Biogeographic Assessment. In a related effort, protocols are currently being developed in Puerto Rico to determine the extent and magnitude of chemical contaminant gradients in coral reef ecosystems. If successful, recommendations will be made as to how they should be applied to the TER.

## BACKGROUND

### *Biogeographic Assessment of Reef Fish and Habitats*

The TER is a 391-km<sup>2</sup> no-take area set aside to protect the critical coral reef ecosystem of the Tortugas region. The reserve consists of two non-contiguous sections: Tortugas North and Tortugas South, which are located about 113 km west of Key West and 225 km from mainland Florida (Figure 1; NOAA, 2000). Because of its upstream oceanographic position, the Tortugas region is considered critical to the function and dynamics of the wider south Florida coral reef ecosystem, and may be a primary spawning ground for the repopulation of organisms that support fishery production (Lee and Williams, 1999; Ault et al., 2002, 2005). Although remote from urban development, the region still is threatened by overfishing and habitat degradation from resource extraction and use in adjacent unprotected waters. A primary goal of the TER is to protect large contiguous diverse habitats in order to preserve biological diversity, maintain resource quality, and ultimately, to provide replenishment to adjacent surrounding areas (NOAA, 2000). Coral reef ecosystems are biologically and architecturally complex and exhibit considerable spatial and temporal variation in both of these attributes. Thus, protection of these habitats and living resources requires a characterization of available habitats, and an understanding of the fundamental role of these habitats in determining the structure and dynamics of living resources that use them.

Biogeographic analyses are ideal tools for Sanctuary managers to utilize for conservation of biodiversity and ecosystem integrity across a wide spectrum of spatial and temporal scales (Figure 2). Through

biogeographic analyses, it is possible to predict where, when, and why organism or habitat distributions may change as a result of gradual processes such as the slow accumulation of pollutants or, to rapid extreme events such as hurricanes (Livingston et al., 2000). Most notably biogeographic approaches are central to spatial management issues such as those addressed in the Sanctuaries and more specifically, the TER. To properly manage resources, Sanctuary personnel require a thorough understanding of resource distribution relative to Sanctuary boundaries. Furthermore, completing a biogeographic assessment of the distribution of resources within and across Sanctuary boundaries is critical for placing them into their wider ecological context and understanding how the composition of the ecosystem changes over time. Coupling data layers depicting animal and habitat distributions with data on human and natural threats provides a powerful predictive tool for Sanctuary managers (see NOAA, 2005).

NCCOS<sup>1</sup> and its partners have been developing a suite of biogeographic and ecological databases for the Dry Tortugas and US Caribbean for the past 5 years. Several studies have characterized and mapped benthic habitats, defined ecological linkages and physical oceanographic patterns, and determined the habitat utilization patterns of reef fish (Schmidt et al., 1999; Jeffrey et al., 2001; Christensen et al., 2003; Kendall et al., 2003, 2004; Burke et al., 2004; Jeffrey, 2004). A complementary body of work is underway at the NMFS<sup>2</sup> Southeast Fisheries Science Center in consultation with the University of Miami (Ault et al., 2001; Ault et al., 2005). Although these studies have specific objectives and testable hypotheses, no effort is yet underway to integrate the evolving data sets to conduct targeted field studies that address gaps in data collection for conservation management needs. The effort proposed below would result in an Integrated Assessment of the region based on the principles of biogeography, and also would provide a unique opportunity to examine several potential ecosystem effects within and adjacent to the TER.

The proposed Integrated Biogeographic Assessment study will integrate data from CCMA<sup>3</sup>, CCFHR<sup>4</sup>, CSCOR<sup>5</sup>, NMFS, University of Miami, and the State of Florida into the biogeographic assessment framework developed by CCMA and currently being used and implemented in NOAA National Marine Sanctuaries. This framework will enable organization of existing biogeographic (habitat, biological, and oceanographic) data in comparable and consistent temporal and spatial frameworks to address the objectives listed above.

#### *Assessment of Human Dimensions*

The TER has been the focus of much ecological and socioeconomic research on coral reef ecosystems. Much of the socioeconomic research occurred before reserve establishment and focused on some but not all human activities or interests (e.g., Leeworthy et al., 2000, 2004). While this research is substantial, additional work is needed on other aspects of human dimensions research. In addition, the approach (or framework) for incorporating human dimensions information into an overall research package and management understanding, is lacking. This information and approach are necessary to determine potential societal benefits or impacts from reserve implementation.

The human dimensions component of this project will expand upon the existing research as summarized to include additional stakeholder groups, and approach the various issues and questions from a broader human dimensions perspective (i.e., include a variety of additional social science disciplines and perspectives). The purpose of this project component will be 1) to develop an approach for including human dimensions research and information within an Integrated Biogeographic Assessment for the TER,

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<sup>1</sup> NCCOS: National Centers for Coastal Ocean Science.

<sup>2</sup> NMFS: National Marine Fisheries Service

<sup>3</sup> CCMA: Center for Coastal Monitoring and Assessment

<sup>4</sup> CCFHR: Center for Coastal Habitat and Fisheries Research

<sup>5</sup> CSCOR: Center for Sponsored Coastal Ocean Research

2) to conduct a review of the human dimensions research that is relevant to the TER, and 3) to produce a summary document that would be a useful component of an Integrated Biogeographic Assessment and would support management of the TER. Project personnel will work closely with NCCOS and NMSP staff to ensure that the resulting science products will meet the needs of the agency and its mission.

**Questions to be addressed by the Integrated Biogeographic Assessment include:**

1. What habitats in the TER are of known importance to living resources and where are they located?
2. What are the spatial/temporal patterns in the distribution of fish species and assemblages within the TER? Are particular biological hotspots evident in space and time? Where are suitable habitats for species of particular importance?
3. How can we define bio-physical relationships and connectivity via models of species occurrence or abundance in the TER? Can models of fish community structure for the US Caribbean and Florida be used to predict ecosystem responses to the TER?
4. What information on human dimensions research exists and how can such information be used to help guide management of resource use in and around the TER?
5. What work has been done to identify levels of toxic contaminants, nutrients, and pathogens in the TER, and what additional work is needed to improve our understanding of the role of chemical stressors in this region?

**PROJECT TASKS**

Below are brief descriptions of tasks planned for the Integrated Biogeographic Assessment of the TER.

**Task 1. Project Planning and Implementation**

This work plan describes the overall project and serves as a blueprint for its implementation. Although specific products are identified in this document, the final products are dependent on the quality, quantity, and availability of data for analyses; hence, close collaboration among partners and guidance from National Marine Sanctuaries Program (NMSP) staff will be required.

A meeting among staff from CCMA's Biogeography (BT) and Chemical Impacts (CIT) Teams, CCFHR, National Ocean Service's (NOS) Special Projects Office (SPO), and University of Massachusetts was held during March 2005 at Beaufort, NC to develop the questions and objectives outlined above. Additional meetings will be held with staff of the NMSP and project collaborators to ensure the project results will meet the resource management priorities for NMSP, and that the most important species, habitat types, and data sets are selected for analyses. Additionally, the spatial domain of the study area must be defined. The current consensus is to use the TER study area defined in Leeworthy et al., 2000.

**Specific Tasks and Products:**

1. Development of a draft implementation plan for review
2. A preliminary list of data sets to be used in the analyses
3. A preliminary list of deliverables

*Lead: Christopher Jeffrey*



## **Task 2. Development of GIS Base (map) Layers for Biogeographic Assessments (obj. #1)**

The development of comprehensive benthic habitat, bathymetry, and oceanographic maps will fill current data gaps and also provide base layers for the Integrated Biogeographic Assessment study. Development of robust maps will require an inventory of existing datasets and additional data currently being collected. The primary path for identifying relevant data sets for map development will be via telephone and email surveys with Sanctuary staff and regional benthic mapping experts. For example, a map of aggregated bathymetry data assembled by Dave Palandro for South Florida has been sent to CCFHR by SPO. In addition, the utility of NOS data holdings will be assessed to determine data sets relevant to the TER. Ault et al., (2001) list a series of benthic habitat and oceanographic datasets for the TER, which could be used as a starting point for the inventory. The overall accuracy of the final map will be affected by problems associated with the use of different sensors and mapping techniques to characterize the TER across varying geographic scales. Micro-scale habitat data collected by CCFHR and UNC-NURC could be used for map validation. The goal is to produce the best habitat map possible based on available data.

### **Specific Tasks and Products:**

1. Development of an oceanographic base map of ocean current direction and magnitude
2. Development of a habitat base map
3. Development of a bathymetry base map
4. Validation of final map with micro-scale habitat data

*Lead:* Jerry Ault and Steve Rohmann

## **Task 3. Biogeographic Synthesis of Fish-Habitat Relationships (obj. #2)**

Collaborators will conduct a series of analyses to model the spatial and temporal distribution of selected fish species and community assemblage metrics in order to identify key biological areas and time periods based on: species distributions, species life history requirements and habitat affinities, the distribution of habitats, and measures of community structure (e.g., species diversity). Analyses will focus on the CCFHR and Ault-Bohnsack datasets.

### **Specific Tasks and Products:**

1. Summary report on the distribution of selected species among habitats of the TER
2. GIS maps of species distribution biological hotspots (e.g., areas of high biodiversity) in the TER

*Leads:* Jerry Ault and Chris Caldow

## **Task 4. Biogeographic Assessment Models: Assessment of Ecosystem Response (obj. #3)**

Fish-habitat relationships developed from **Task #3** will be used to model connectivity relationships and to assess or predict potential refugia benefits (e.g., spillover, replenishment) to surrounding areas. These analyses will describe spatial patterns in the biological response of ecosystem components to the TER. Additionally, models of fish community structure developed by CCMA's BT in the US Caribbean and University of Miami in Florida will be used to identify ecological benefits of the TER.

### **Specific Tasks and Products:**

1. Selection of representative species and community assemblage metrics for spatial modeling
2. Development of spatial models
3. Summary document describing the spatial model and model results

*Leads:* Matt Kendall and Jerry Ault

#### **Task 5. Human Dimensions Research (obj. #4)**

A hierarchical approach to the deliverables listed below is proposed. Because limited data exist, and because the “framework” for conducting an assessment of human dimensions does not exist, a ground up perspective consistent with the NCCOS Strategic Plan will be used. Additionally, specific methods acceptable to the social science professions and appropriate to each identified task will be employed.

##### **Specific Tasks and Products:**

1. An initial draft framework for incorporating human dimensions into an Integrated Biogeographic Assessment for the Dry Tortugas (and for coral reef ecosystems in general). The framework should be useful and applicable in developing future Integrated Assessments for other coral reef ecosystems.
2. Based upon a thorough review of the existing human dimensions literature concerning the TER, and coral reef ecosystems, weaknesses or holes in the literature relative to the TER will be identified.
3. An initial human dimensions baseline assessment will be developed based on what is currently known about the TER. This, in combination with the framework developed in **Task # 5.1**, will also provide guidance in determining what additional information is needed. This is the first step in producing an Integrated Biogeographic Assessment.

*Lead:* David Loomis

#### **Task 6. Assessment of Toxic Contaminants, Nutrients, and Pathogens**

The Dry Tortugas region has experienced impacts from human use (i.e. fishing), but because of its remote location, it is unclear whether chemical contaminants are significantly impacting the TER. Thus, an extensive literature review will be conducted to assess the availability of data and to identify gaps in current data on chemical impacts in the TER. If existing research suggests that chemical impacts are a major issue, then information being collected by CCMA’s Chemical Impacts Team (CIT) in a concurrent assessment of chemical impacts in the Puerto Rico will be used to determine how best to incorporate data on chemical stressors in the future. Assessments of potential chemical impacts on the reefs in the Dry Tortugas and US Caribbean will provide an additional metric of reef stress, which will enable an assessment of coral ecosystem status across a continuum of level of stress in each region.

##### **Specific Product:**

Review of available data on chemical contaminants and impacts on reefs of the TER.

*Leads:* Tony Pait and John Christensen

#### **Task 7. Synthesis and Integration of Project Components**

Project components will be synthesized and integrated into a final report that will be the “Integrated Assessment” of the TER. The final report will consist of a series of chapters with each chapter summarizing a component or objective addressed by this project.

**Specific Product:** The final report. A suggested title is “An Integrated Biogeographic Assessment of the TER: 2006.”

*Lead:* Christopher Jeffrey

## **Task 8. Dissemination of Preliminary and Final Products**

A project web site will be developed and will be the primary tool for dissemination of preliminary and final products developed from this project. Hard copies of reports, maps and other documents will also be produced as needed by project participants for the public.

*Specific Product:* A project web site

*Lead:* Tom McGrath

## **SCHEDULE**

The project is planned for completion by December 31, 2006. Thus, the goal is to have the final product disseminated to the public by the project's ending date. Figure 3 shows a proposed schedule, but a more detailed project schedule will be developed based on input from all project partners.

## **PROJECT PERSONNEL**

### **CCMA Biogeography Team:**

Mark Monaco (Team Leader, Co-PI)

Chris Jeffrey (Project Manager)

Chris Caldow, Matt Kendall, Tom McGrath, Simon Pittman, and Charles Menza

### **CCMA Chemical Impacts Team:**

John Christensen (Team Leader)

Tony Pait and Rob Warner

### **NOS Special Projects Office**

Bob Leeworthy

Steve Rohmann

### **CCFHR Staff:**

Mark Fonseca (Team leader, Co-PI)

Christine Addison, John Burke, Don Field, Jud Kenworthy, Amit Malhotra, Vanessa Nero, Amy Uhrin, Shay Viehman, and Lisa Wood

### **Other Project Participants:**

#### **Human Dimensions Research:**

David Loomis (University of Massachusetts-Amherst)

Robert B. Ditton (Texas A&M University)

Doug Lipton (University of Maryland)

Jerry Vaske (Colorado State University)

#### **Reef Fishes and Habitat Research:**

Jerry Ault, Jiangang Luo, and Steve Smith (University of Miami, FL)

James Bohnsack (National Marine Fisheries Service)

Billy Causey and Brian Keller (Florida Keys National Marine Sanctuary)

Steven Miller (UNC-Wilmington-NURC)

Additionally, staff of the NMSP (especially FKNMS staff) will be consulted regularly for project review and data identification, collection, and synthesis. Interim products will be offered for review at several

points during the project in addition to those noted in this task list. Collaboration with sanctuary research staff is essential to ensure that deliverables will meet NMSP expectations.

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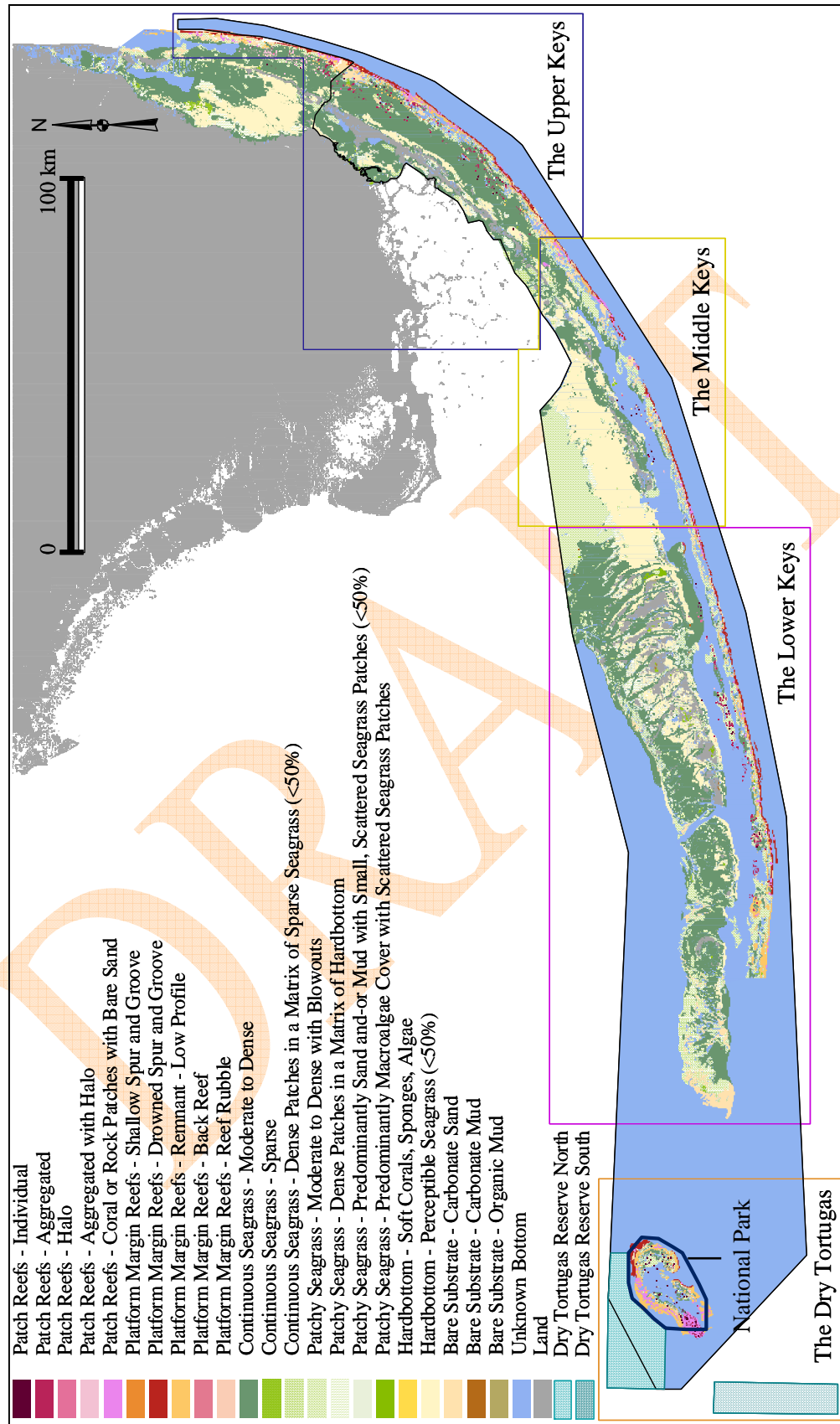
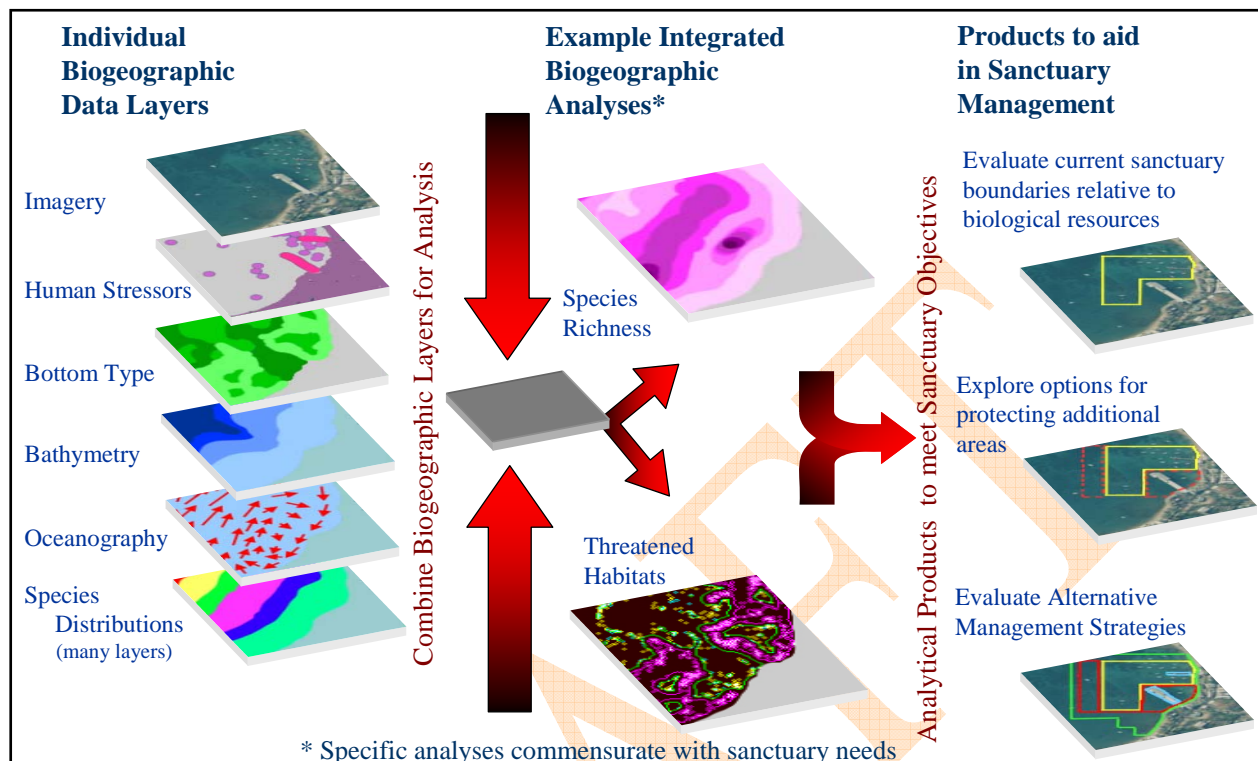


Figure 1. Map of benthic habitats, regions, and management jurisdictions occurring in South Florida (FMRI and NOAA 1998).

Figure 2. What can a biogeographic approach do for Sanctuaries?



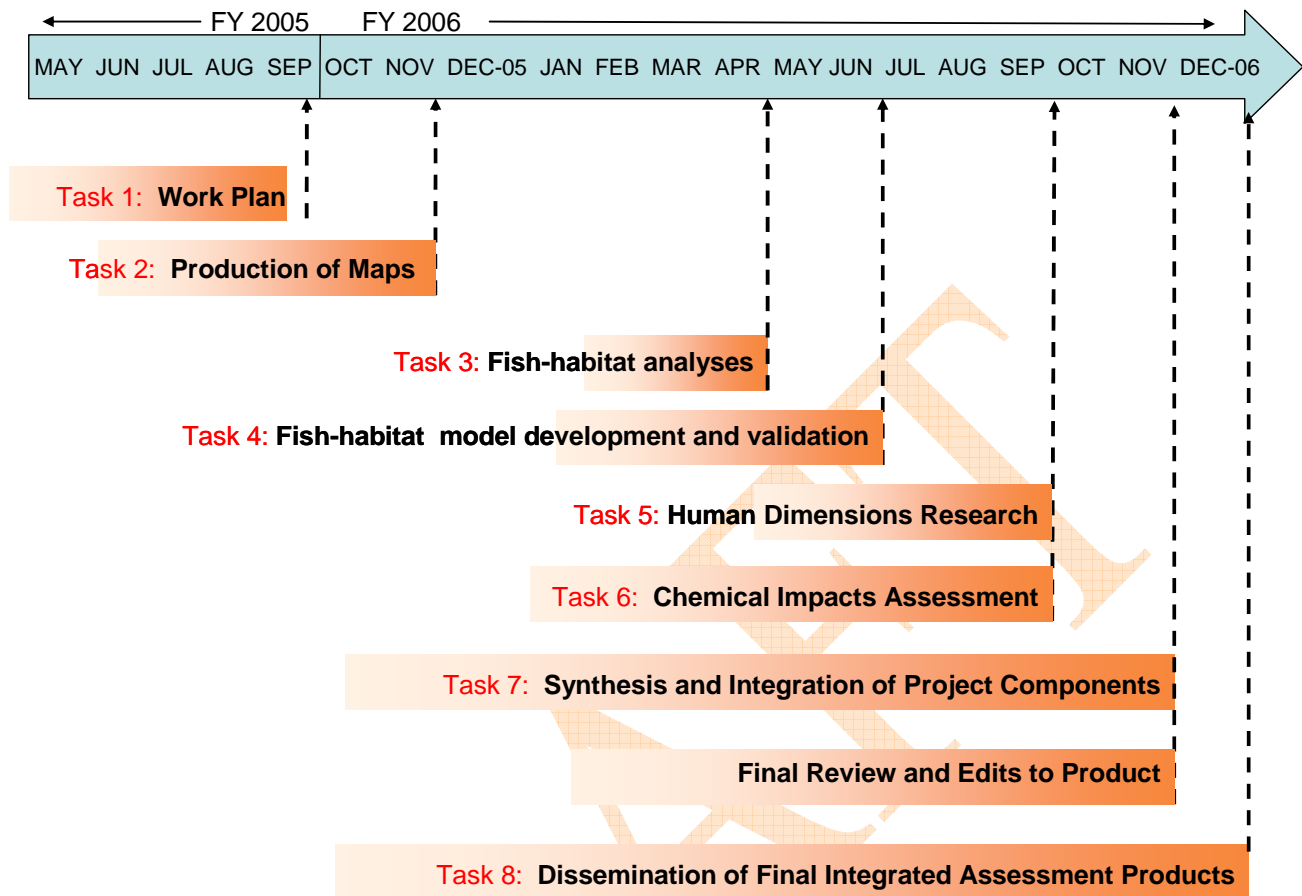


Figure 3. Schedule for completing components of the Integrated Biogeographic Assessment of the Tortugas Ecological Reserve.